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Attorney Docket No. \_\_\_\_\_

DECLARATION AND POWER OF ATTORNEY**COPY**

This declaration is of the following type:

☒ [ V ] original            ☐ [ ] design            ☐ [ ] supplemental  
☐ [ ] national stage of PCT  
☐ [ ] divisional            ☐ [ ] continuation            ☐ [ ] continuation-in-part

As a below name inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe that I am the original, first and sole inventor (*if only one name is listed below*) or an original, first, and joint inventor (*if plural names are listed below*) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**Superconducting Magnesium Diboride Thin Film and Method and Apparatus  
for Fabricating the Same**

the specification of which:

☒ [V] is attached hereto.

(Check one)

☐ [ ] was filed on \_\_\_\_\_ as Serial No. \_\_\_\_\_  
and was amended on \_\_\_\_\_  
(*if applicable*).

☐ [ ] was described and claimed in PCT International  
Application No. PCT/\_\_\_\_\_ filed  
on \_\_\_\_\_ and as amended pursuant  
to PCT Article 19 on \_\_\_\_\_ (*if any*).

I state that I have reviewed and understand the contents of the specification identified above, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to the examination of the application identified above in accordance with 37 CFR § 1.56.

I claim foreign priority benefits pursuant to 35 USC § 119(a) of any foreign application(s) for patent or inventor's certificate or of any PCT international patent application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent, utility model, design registration, or inventor's certificate or any PCT international patent

application(s) designating at least one country other than the United States of America filed by me for the same invention and having a filing date before that of the application(s) from which the benefit of priority is claimed.

**PRIOR FOREIGN PATENT, UTILITY MODEL, AND DESIGN REGISTRATION  
APPLICATION, BENEFIT CLAIMED UNDER 35 USC § 119(a)**

Priority Claimed  
Under 35 USC § 119(a)

<u>Rep. of Korea</u>	<u>2001-14042</u>	<u>19/March/2001</u>	Yes <u>V</u>	No <u>  </u>
(Country)	(Prior Foreign Application No.)	(Day/Month/Year Filed)		
<hr/>			Yes <u>  </u>	No <u>  </u>
(Country)	(Prior Foreign Application No.)	(Day/Month/Year Filed)		

I claim the benefit pursuant to 35 USC § 119(e) of the following United States Provisional patent application(s):

**PRIOR U.S. PROVISIONAL PATENT APPLICATIONS,  
BENEFIT CLAIMED UNDER 35 USC § 119(e)**

<hr/> Application No.	Filing Date (day,month,year)
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<hr/> Application No.	Filing Date (day,month,year)
-----------------------	------------------------------

I claim the benefit pursuant to 35 USC § 120 of any United States patent application(s) or PCT international patent application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this patent application is not disclosed in the prior patent application(s) in the manner provided by the first paragraph of 35 USC § 112, I acknowledge the duty to disclose material information as defined in 37 CFR § 1.56 effective between the filing date of the prior patent application(s) and the national or PCT international filing date of this patent application.

**PRIOR U.S. PATENT APPLICATIONS OR PCT INTERNATIONAL PATENT  
APPLICATIONS DESIGNATING THE U.S., BENEFIT CLAIMED UNDER 35 USC § 120**

U.S. PATENT APPLICATIONS

STATUS

Application Serial No.	U.S. Filing Date	(Pat./Pend./Aban.)
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Application Serial No.	Filing Date	Status (Pat./Pend./Aban.)
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**PCT APPLICATIONS DESIGNATING THE U.S.**

**STATUS**

Application No.	Filing Date	U.S. Serial Nos. Assigned (if any)	(Pat./Pend./Aban.)
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Application No.	Filing Date	U.S. Serial Nos. Assigned (if any)	(Pat./Pend./Aban.)
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As a named inventor, I appoint the following attorneys to prosecute this application and transact all business in the Patent and Trademark Office connected with this patent application.

John M. Belz, Reg. 30,359  
Jeffrey A. Wyand, Reg. 29,458  
Jeremy M. Jay, Reg. 33,587

Michael H. Tobias, Reg. 32,948  
Gregory A. Hunt, Reg. 41,085

Patrick R. Jewik, Reg. 40,456  
Joseph S. Ostroff, Reg. 39,321

I further direct that correspondence concerning this application be sent to:

**LEYDIG, VOIT & MAYER, LTD.**  
700 Thirteenth Street, N.W., Suite 300  
Washington, D.C. 20005-3960  
Telephone (202) 737-6770

I authorize my attorneys to accept and follow instructions from \_\_\_\_\_ regarding any matter related to the preparation, examination, grant, and maintenance of the patent application identified above, any continuation, continuation-in-part, or divisional patent application based on the patent application identified above, and any patent issuing from that patent application, until I or my assigns withdraw this

authorization in writing.

I declare that all statements made herein of my own knowledge are true, that all statements made on information and belief are believed to be true, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: Won nam Kang

Inventor's signature WN Kang

Date: 30 / Nov / 2001

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Inventor's signature Sung ik Lee

Date: 03 / Dec / 2001

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Inventor's signature Choi

Date: 04 / Dec / 2001

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Full name of fourth joint inventor: Hyeong-jin Kim

Inventor's signature Hyeong-jin Kim

Date:

04 / Dec / 2001

Residence: Dept. of Physics, Pohang University of Science and Technology  
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Citizenship: Korean

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## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : New Application  
Applicant : Won nam KANG et al.  
Filed : Herewith  
TC/A.U. : Not Yet Assigned  
Examiner : Not Yet Assigned

Docket No. : 1751-301.CON  
Customer No. : 06449  
Confirmation No. : Not Yet Assigned

Director of the United States Patent  
and Trademark Office  
P.O. Box 1450  
Alexandria, Virginia 22313-1450

### **DECLARATION UNDER 37 C.F.R. § 1.132**

I, Dr. Won nam Kang, do declare and state that:

I am a co-inventor of the above-identified application.

I received a Bachelor of Science in Physics in August 1987, a Master of Science in Physics in February 1990, and a Ph.D. in Physics in February 1994 from the Sungkyunkwan University in South Korea.

I am presently a Research Associate Professor at the Pohang University of Science and Technology in South Korea. I worked for the University of Kansas as a Post-Doctor from September 1995 through July 1996, and the University of Houston as a Research Associate Professor from July 1996 through May 1998.

#### **A. THE APPLIED REFERENCE**

I have examined the patent application of Won nam Kang et al., Application No. 10/097,975, filed March 15, 2002 including the Amendment filed September 10, 2003 under 37 C.F.R. § 1.111. I have also examined the final Office Action of the Patent

Office dated November 20, 2003 and, in particular, the Finnemore et al. reference (U.S. Patent No. 6,514,557).

As a result of my detailed review of the above items, I would like to make the following observations.

### **U.S. Patent No. 6,514,557 (Finnemore)**

Finnemore is directed to a method of manufacturing a *magnesium diboride wire*. The magnesium diboride wire is obtained by reacting a boron object with magnesium vapor at or near 950°C for approximately two hours. See, e.g., Fig. 1a.

### **B. THE PRESENT INVENTION**

In the present invention, the sole pending claim 1 provides a method of manufacturing a *magnesium diboride thin film*. Claim 1 further provides that a substrate with boron thin film and a magnesium source are placed inside a heat source, rapidly heated for 10-60 minutes, and then cooled. The heating temperature is equal to or greater than 600°C and less than 950°C. This rapid thermal process can effectively prevent degradation of the magnesium diboride thin film caused by chemical reaction with the substrate underlying the magnesium diboride thin film.

### **C. DISCUSSION**

After carefully reviewing the Finnemore reference cited by the Patent Office, in my opinion, the present invention, as set forth in claim 1, is not anticipated by or obvious in view of the Finnemore reference. A detailed explanation for my conclusion follows.

I conducted an experimentation in the same manner described in the article entitled, "Growth of superconducting MgB<sub>2</sub> thin films via postannealing techniques," W. N. Kang et al., Physica C, pp. 24-30 (2003), per copy enclosed.



Figure 4 of the article illustrates magnetic field dependence of critical current density ( $J_c$ ) at 5 K for samples M700C30m, M800C30m, M900C30m, M950C30m, M900C60m, and M900C120m.  $J_c$  is a very important factor for use in practical applications of high-field superconducting magnet systems.

M900C120m and M950C30m are samples of the Finnmere reference, and M700C30m, M800C30m, M900C30m and M900C60m are samples of the present invention. Referring again to Figure 4, the  $J_c$  values of samples M900C120m and M950C30m are approximately 6 MA/cm<sup>2</sup> at zero field, and the  $J_c$  value of sample M900C30m is approximately 20A/cm<sup>2</sup> at zero field. As such, the  $J_c$  values of the samples of the present invention at zero field are approximately three times greater than those of the Finnmere reference. Accordingly, as the value of  $J_c$  at zero field increases, the superconducting characteristics of the samples are improved.

The magnetic field dependence of  $J_c$  of the samples shows different behavior. The samples annealed at less than 950°C for a short period of time (e.g., 30 minutes), show weak-field dependence compared to samples M900C120m and M950C30m. Sample M950C30m shows a very dense surface morphology highly oriented along the c-axis when compared to sample M900C120m. The strong-field dependence of  $J_c$  implies that the sample contains fewer pinning sites than M900C30m. The  $J_c$  data supports the fabrication process for sample M900C30m according to the present invention being the optimal condition for large-scale applications.

Also, referring to Figure 3 of the article, the superconducting transition temperature ( $T_c$ ) and transition width ( $\Delta T_c$ ) depends greatly on the annealing temperature and time. In general, the superconducting characteristic improves as  $T_c$  increases and  $\Delta T_c$  decreases. Specifically, in Figure 3(b), the sample annealed for 120 minutes shows a lower  $T_c$  and a broad superconducting transition indicating that longer annealing degrades superconductivity by changing the growth orientation of MgB<sub>2</sub>.

In view of the foregoing reasons, I believe that the present invention as set forth in claim 1 is not anticipated by or obvious in view of the Finnemore reference.

D. CONCLUSION

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: \_\_\_\_\_

\_\_\_\_\_  
Dr. Won nam Kang

Enclosure: "Growth of superconducting  $\text{MgB}_2$  thin films via postannealing techniques," 1 *Physica C* 385 (2003) 24-30.

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